Emerging Issues for Commuter Choice Applications Through Integration of Public Transportation Fare Media Technology

Technical Report

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1. BACKGROUND ON COMMUTER CHOICE PROGRAM

Throughout the United States, transportation providers are steadily increasing their time devoted to working with employers to encourage the use of alternative transportation modes. The Commuter Choice Program developed by the Federal Government, also known as a transportation fringe benefit, is designed to offer employers certain tax benefits for their employees who commute to work by way of public transit, commuter rail, vanpool, and ferry. [United States Code, Title 26, Section 132(f).] There are two primary ways in which employers can provide benefits to the employee. One is through prepaid fare media such as passes or tickets, and the second is through vouchers valid for qualified transportation indicated above. The tax benefit is eligible for the first $100 of each calendar month's commuting cost.

1.1 Employer Participation

The cornerstone of the Commuter Choice Program is built on employers. In nearly all situations in Michigan the employer is required to purchase the transportation fare media and distribute to employees. A brief description of how employer participation can be structured along with different types of benefits is provided below.

1.1(a) Employer Provided Benefit

In a traditional fringe benefit form, employees may receive the monthly transportation benefit in addition to their current wages free of all Federal payroll and income taxes. In Michigan, wages are also free from State income taxes. The employer pays for the benefit by purchasing fare media, which can be used as a business tax deduction. Employers view this as a way of attracting and retaining qualified workers, while employees view it as a fringe benefit.

1.1(b) Pre-Tax Benefit for Employees

As a pre-tax transportation fringe benefit, the employer may permit employees to set aside an amount of money before taxes to pay for qualified transportation benefits. The employer purchases and distributes the fare media and reimburses itself with the

employee's pre-tax contribution. The employee would not pay Federal or Michigan income taxes. Neither the employer nor employees would pay payroll taxes on the employee's pre-tax deduction.

1.1(c) Cost Sharing

Both the employee and employer using a combination of the two options described above may share the cost of the transportation benefit. In this scenario, employers may only receive a deduction in business taxes for the portion of transportation benefits (fare media) they pay for. The cost sharing approach is attractive to employers who desire to help pay for employee transportation costs but who are either unable or unwilling to pay the entire amount.

1.1(d) Program Benefits

The use of such programs has many benefits for both employers and employees. A summary of these benefits is presented in Table 1.

Employees	Employers	Transportation Providers
-More economical use of public transportation -More choice in how to get to and from work and pay for it -Lower Federal and Michigan income taxes and Federal payroll taxes when pre-tax transportation accounts are provided by employers -Arrive to work on time -More opportunities for work	-Reduced Federal and Michigan income taxes and Federal payroll taxes -Receive business tax deductions -Incentive to attract new employees -Incentive to retain existing employees -Reduced absenteeism -Perceived as promoting the improvement of the environment and road conditions in the area	-Increased use of alternative transportation -Increased transit ridership -Reduced congestion on roadways -Improvement of environment and road conditions in area

Table 1 Benefits Under the Commuter Choice Program

1.2 Barriers

While there are benefits for all parties involved, transportation providers still have a difficult task at hand when developing Commuter Choice Programs. Besides administrating the programs, they must generate enough interest in such programs at the employer level to make the program viable. An employer will find it more attractive to participate if there are no major barriers to implement such programs. Some of these barriers may be real, while others may be perceived. Transportation providers must fully understand the nature of the barriers and assist the employers to overcome them and build their programs, so as to suit the needs of current and future employers. A discussion of these employer barriers is presented below.

1.2(a) Employers with Multiple Locations

Employers may face a barrier if they have locations in multiple cities served by several different transportation providers. This is a barrier because the employer may have to deal with several different transportation providers with different fare media and prices. Dealing with multiple fare structures and agency payment policies is cumbersome and time consuming for the employer. An example would be a corporate office located in Detroit with branch offices scattered throughout the suburbs or as far away as Flint, Grand Rapids, Gaylord and Marquette.

The location barrier can become more complicated when unionized labor is involved. If the employer offers such transportation fringe benefits at one location, it must offer similar benefits to employees at all locations. Providing transportation benefits to different employees in a non-equitable manner may not be considered a fair business practice by labor unions.

1.2(b) Purchase and Distribution of Fare Media

Purchasing and distributing the fare media or vouchers may be difficult if multiple transportation providers are involved, particularly when significant distances separate these agencies.

1.2(c) Incompatibilities with Technology and Administration

Technical incompatibilities between transportation providers may arise for employer participation if an employee would like to use his/her transportation benefit with multiple agencies. Incompatibilities of fare media between different providers may require the employer to purchase different types of fare media. This may not appeal to the employer or employees.

Administrative incompatibilities between transportation providers may pose a similar problem. If vouchers or other media are only accepted at some agencies, or if each agency administers its own commuter choice program in an isolated manner, an employer may find it difficult to satisfy its employees that utilize multiple service providers.

1.2(d) Fare Media Purchase Options

Some employers may be reluctant to participate in a Commuter Choice Program if the transportation provider is not providing a variety of fare media options. Variety could include fare media with stored rides, stored value, time based or other types of vouchers. Stored-ride media contain a specific number of rides, while fare media contain a specific amount of value for use. Time based media is valid for a specified duration. Vouchers can be used by the employee, like cash, to purchase any type of fare media they choose. Each have its own advantages and disadvantages, but an employer may not participate in a Commuter Choice Program if the most desirable media from the employees' perspective is not available. Fare media options can also become a barrier to employers that choose to share the cost or pay only a fraction of the cost as a benefit.

1.3 Possible Solutions

There are many possible solutions to barriers of employer participation, each of which depends on the specific circumstances of the parties involved. However, the key to the success of a Commuter Choice program is the willingness of the employer to participate in such a program, with the objective of extending additional fringe benefits to their employees. The responsibility of the provider is to assess what employers want in a

program for their employees, and to develop programs to fit the needs identified. There are several measures that agencies may take to minimize barriers that employers face.

The barriers employers face in participating in transportation benefit programs may be eliminated in several different ways by actions and decisions from transportation providers. There is not any correct or perfect way to increase participation. It is also impossible to alleviate every barrier to employer participation. A discussion of possible solutions is provided below.

1.3(a) Collaboration Between Transportation Providers

Transportation providers that find employers reluctant to participate in Commuter Choice programs because of the lack of cohesiveness between providers may want to form a single collaborative program. The program could be administered by a lead agency, a third party or a group of service providers. It can be as comprehensive or as simple as the situation warrants.

1.3(b) Universal Voucher

A simple program could utilize a universal voucher accepted by participating agencies. Distance of company locations and choice of participating providers would no longer be a barrier, since the vouchers could be accepted at any participating agency. The funds would be applied directly to the transportation provider of the employee's choice.

1.3(c) Universal Pass

A more complicated program could involve a universal pass accepted by all participating transportation providers. Depending on how technically advanced the fare collection systems are, a pass program could be set up in several different manners. Ideally, all the agencies should have the means to use a pass that actively allocates the fares to the appropriate agencies. If the agencies have different technical capabilities, fare media in the form of a flash pass with ridership manually recorded by the driver, could be utilized or technology could be upgraded to achieve compatibility. If a flash

pass or any type of similar pass where fare is not allocated to the appropriate agency is used, then an appropriate allocation system should be set up between the agencies to distribute the fare equitably.

1.3(d) Fare Media Options for Private Sector Cost Sharing

Another measure that transportation providers can take is to offer more variety in fare media options. For example, if an employer is willing to pay $20 of the transportation benefit, but there is not a way to provide the exact amount in fare media in some form, then the employer may be discouraged from participating in the program. If the agencies involved were to implement a $20 voucher or $20 stored value media, then the employer may be a willing participant in the program. The burden in such cases will be on the transportation provider to take the extra step and "tailor" a program to suit the need of the employer. The gain in ridership and revenue clearly could serve as the incentive for the agency to take the extra step.

1.3(e) Fare Integration Between Transportation Providers

A fare integration effort between transportation providers may also increase participation among employers for a Commuter Choice Program. While this could be a major undertaking by service providers, a comprehensive Commuter Choice Program can arise out of this effort.

An agency or a group of agencies planning to undertake a program to increase commuter choice participation must always keep in mind the employer's needs. In some cases, the employer may be willing to settle for simplicity of operation, even though it might result in a marginal increase in cost to the employer. In other cases, the primary objective of the employers is to provide employees with transportation benefits with minimal costs, or to provide such benefits to their employees within the constraint of a fixed budget. The key to success of a Commuter Choice Program is in designing a program by the agency that is most responsive to the needs of the employer when multiple employers are involved. The agency may have to develop creative packages that suit the needs of all or the majority of the employers.

2. PURPOSE OF STUDY

Public transportation serves as a crucial means of travel for many employees to commute to work. It is a vital link to work for those who cannot afford cars or who do not have access to other means of transportation. However, a majority of the work force uses the private automobile and does not depend on public transportation for their commute to work. The dominance of the private auto for work and other purposes has contributed significantly to traffic congestion and emission problems in our urban areas. Increased use of public transportation, it is felt, will help alleviate/reduce such congestion and emission problems that typify our transportation network. Governmental agencies at the federal, state, and local level have been working toward creative means of promoting the use of public transportation in our urban areas.

One of such programs undertaken by the Federal Government, in conjunction with state and local agencies, is the Commuter Choice program. As previously mentioned, the Commuter Choice Program provides tax incentives for employers and their employees who use public transportation and vanpooling to commute to and from work. Many programs have been developed by public transportation providers utilizing the Commuter Choice tax benefit. Unfortunately, employer involvement remains low due to a lack of awareness or a misconception of high administrative burden.

2.1 Problem Statement

A lack of motivating factors has thwarted the use of Commuter Choice tax benefits by employers. Because of this, the Michigan Department of Transportation (MDOT) is exploring alternatives to promote the use of the Commuter Choice program to employers. One of the goals of the Commuter Choice program is to provide "one stop shopping" for employers who desire to purchase transportation benefits for employees and take advantage of the tax benefits. "One stop shopping" is the concept that will allow employers to purchase fare media for their employees and complete all necessary

transactions in one encounter, even when multi-jurisdiction travel involving a number of transportation providers may be required.

As future trends in multi-jurisdictional travel occurs, in part due to urban sprawl, the success of such "one stop shopping" may depend upon the use of appropriate fare media technology and reimbursement procedures between transportation providers. Ultimately, MDOT would like to see increased transit ridership on public transportation and vanpools in the state, increased number of employers participating in the Commuter Choice Program, transit agencies providing seamless travel, and a simplified process used to acquire fare media by employers.

2.2 Objectives

The broad purpose of this study is to conduct a review of the emerging fare media technologies and to explore how such technologies can be used to promote development of the Commuter Choice Program. This program would be to the mutual advantage of employers through "one stop shopping", employees through seamless travel, and transportation providers through increased ridership. Enhancing the way Michigan's public transportation providers do business in the future hinges on technology. The specific objectives for the study can be stated as follows:

1. Conduct a literature review of fare media technology and related concerns.
2. Identify various fare media systems including their capabilities and limitations.
3. Determine costs associated with fare media technology and related concerns.
4. Identify fare reimbursement processes between systems.
5. Identify potential issues with transfers between systems that may result from using different fare collection technologies.
6. Assess the ability of different fare media technologies in tracking ridership data.
7. Determine how compatibility of fare media technology can promote the Commuter Choice Program.

2.3 Approach

The approach used in this study consisted of a comprehensive literature review on fare media technology and related concerns, followed by interviews of selected transit agencies in Michigan, as well as a sample of out-of-state agencies. The purpose of the interviews was to compile information on what steps, if any, are being taken by the agencies to introduce and implement the evolving new technologies for fare collection, with special attention, if any, given to the Commuter Choice Program. Concurrently with the agency interviews, a set of sample interviews were conducted among selected vendors to obtain information on evolving fare collection hardware/software, price structure, etc. Recommendations were developed based on the information and data collected on appropriate measures to promote the Commuter Choice program utilizing fare media and fare equipment technology.

3. LITERATURE REVIEW

3.1 Introduction

With increasing emphasis on the deployment of new technologies in public transportation operations in the United States, a fundamental change is taking place in fare collection, payment media, and accounting systems. Over the past decade, there has been a trend to modernize cash or coin payments by many transit systems because of a variety of problems associated with them (1). Problems included among other things: need to carry exact change by the passenger, drivers being required to guard large amounts of cash, and the need to keep an exact account of the money at the end of each journey. New systems involve electronic forms of payment media via cards, similar in size to a credit card. There are many reasons why public transportation providers might choose a new system of fare collection. These include seamless regional travel, reduced fare collection costs, additional revenue, improved customer convenience, expanded market base, increased ridership, and a means to automate ridership data collection (1,2).

Because of the advantages offered by the new technology, the past trend of large operators making their autonomous decisions about fare collection is likely to change drastically in the coming decade. The movement is likely to be toward multi-operator systems connecting intra-urban and interurban travel. However, despite the availability of new fare media and evolving payment technologies, these systems are also fraught with potential problems that must be resolved before the technologies receive more widespread use. These include among other things: issues of interoperability, cross agency compatibility, security and fraud, fare management, and cost. While not all of these factors may be relevant for this study, it is clear that fare collection methods will have a profound effect on the operation of public transportation in the coming decade and how it is perceived by the public, particularly when regional travel is concerned.

3.2 Seamless Travel

Promoting travel in a "seamless" manner for the rider is one of the goals of implementing new fare media technology. Seamless travel is the concept used to describe travel that takes place in a continuous manner by minimizing interruptions when transfers between different modes and different agencies are involved. Clearly, the basic prerequisite to such seamless travel is the use of a uniform fare media, both modally and geographically.

In the past, paper transfers between transit agencies operating in metropolitan areas were the answer. Now with new technology, each participating agency should be able to accept other agencies' payments, provided they have the same technical requirements (2,5). It can further evolve to one fare media that is universally acceptable by participating agencies with either a single combined fare structure or through a system designed to retain each individual agencies' fare structure. Thus, the individual agencies may not have to abandon their own fare structure if the appropriate technology is chosen. This process that results in one fare media that is universally acceptable to all participating agencies is often termed as fare integration.

The three types of fare structures, monetary value, stored rides and time based pass, should ultimately be accommodated on the new fare media. A monetary value fare structure is one in which the fare media contains a designated amount of money while a stored ride fare structure is one in which the fare media contains a designated number of rides. Time based fare structures have fare media that are valid for specific time periods, such as a week or month (3,4).

A distinction must be made between selecting new fare media technology and fare integration. A seamless travel system can be attained without any new fare media technology provided proper fare integration arrangements are made between agencies. However, recent interest in emerging technologies has come to include the application of fare media technology as the means to attain seamless travel and fare integration (5).

A new form of fare payment media involving multiple transportation providers will involve many conflicting issues. There will be different views on customer service, systems structure, and administrative operations. From the beginning it is critical to secure the project politically, identify funding, identify system elements and services, identify goals, and define roles and responsibilities (5,6). It is also necessary to establish appropriate business roles, review different ownership models, and identify technical requirements before a new fare media technology can be adopted to promote seamless travel and fare integration.

3.3 Choices

Technology changes everyday throughout the world. What once was today's newest model may be a thing of the past in a matter of months. Apprehension to accept and try new technology is often considered a major impediment to its increased use. The electronic fare media collection is no exception to this rule. While electronic fare collection techniques using cards began in the 1970's, not until the 1990's was its widespread application started in transit operation (1).

New cards have a range of potential functions. They can either be used at more than one agency, but with one type of application (such as transit); or can be used at more than one agency with multiple applications (such as transit, food vendors, and parking). Both of these options are referred to as multipurpose media. The key parameter that distinguishes such multipurpose media from others is what is often referred to as the "Electronic Purse"(EP) of the card (1). The EP is actually the stored-value portion of the card, and there can be several arrangements of the EP to accommodate the range of functions such as stored rides and stored values. Depending on the needs of the transportation provider, such multipurpose media can be used at different levels of complexities as warranted. As with any new technology, there are many choices and issues that first need to be analyzed before implementing a new system.

Most of the recent interest has been in what is termed as a "smart card" (1,3). The smart card is a general term for a type of technology that comprises an integrated circuit card with an onboard microprocessor and built-in logic. There are two main types of smart cards, contact and contact-less, with each of these having more specific subsets. Magnetic stripe cards also represent a valid technology being used currently in dozens of public transportation systems. They can be in operation by themselves or in combination with smart card technology. Further elaboration on card types and uses will follow later in the report.

The key to a successful regional fare payment system is that all transportation providers offering service in the region agree to have the same system or that they incorporate technical means to ensure that the systems are compatible. The type of card technology being used is not actually the first step in implementing fare media technology. The environment or the framework within which the system is to be operated must first be determined.

3.3(a) Environment

A fundamental issue that must first be resolved before or in conjunction with card technology is the environment in which it will operate under. Three types of environments exist; open, closed, and closed multipurpose. Traditionally, public transportation providers have operated in a closed system, however a number of the large-scale systems are exploring the open system for the amenities they offer (1).

3.3(a)(i) Open Systems: In the open system (Figure 1), transit agencies will accept cards issued by one or more non-transit entities, such as banks, universities, or other institutions. A truly open system has multiple card users and multiple service providers or merchants. There are several different types of open systems. The transportation provider can become just like any other merchant in a general program and it can become a partner in the arrangement sharing both the benefits and risks. Alternatively, the agency

can operate its own program, but can also accept other issuer's cards provided they meet the system requirements.

Generally in an open system the transportation provider does not have the responsibility to distribute and reconcile revenue. They usually have less control over the fare system, are susceptible to fraud, and have less flexibility in pricing. However, these are traded off with less financial risk as well as higher card appeal to riders. Examples of this approach include the Ann Arbor Transit Authority/University of Michigan cards trial program (hence discontinued), Atlanta/Visa Cash cards, and Phoenix's (Valley Metro) acceptance of credit cards.

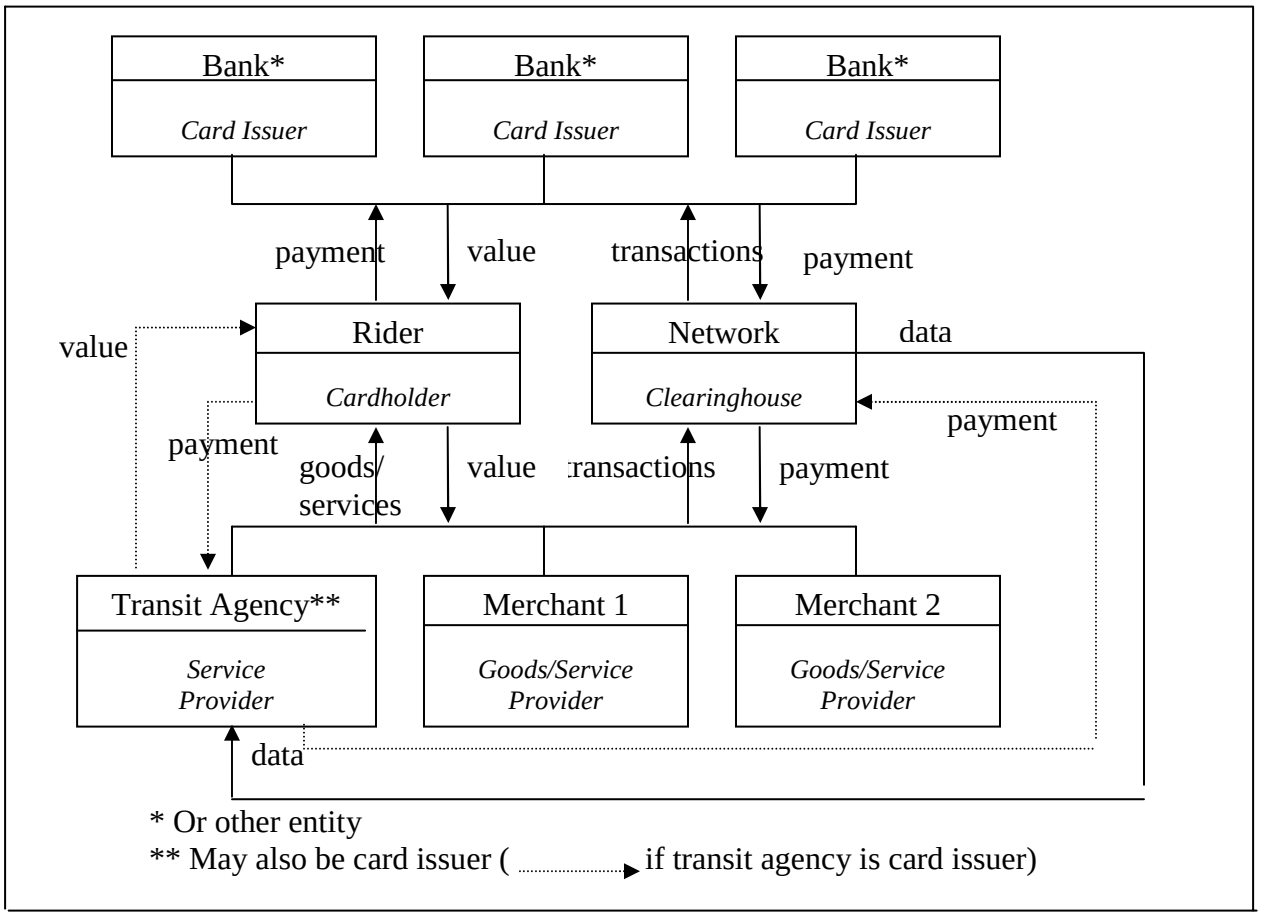

Figure 1 Open Payment System (Source: 1998 TCRP Report 32)

3.3(a)(ii) Closed Systems: The closed system (Figure 2) is a transit only system. This means that the transportation provider, or group of providers, issues and accepts the

cards. The agency can manage and operate the system, or may contract out the work to the private sector. Even though the risk in a closed system is higher than that in an open system, the transportation providers have more potential for the benefits. Higher risks arise from the fact that the transportation providers participating in the program are solely responsible for the operation of the fare media. However, because revenues are to be shared only among a few agencies, potential for benefit can be higher, particularly if the market share of transit is high. The agencies also have to distribute payment media, reconcile revenue and maintain all systems. There will be more flexibility in pricing and less chance of fraud. Examples include the Regional Integration Project in Seattle and Ventura County Smart Passport project in California.

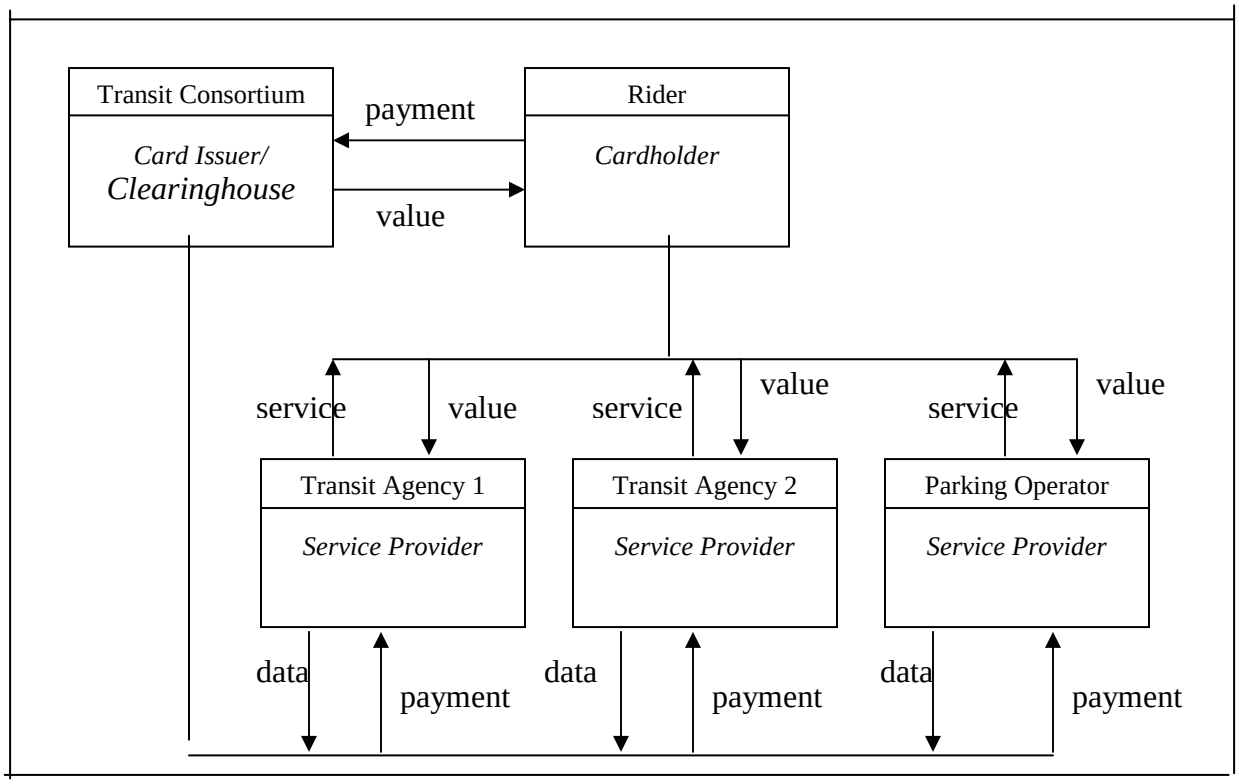

Figure 2 Closed Payment System (Source: 1998 TCRP Report 32)

3.3(a)(iii) Closed Multipurpose Systems: In the closed multipurpose system (Figure 3), the card is produced and managed by the transportation provider (or contracted out), but can still be used for other things such as vending machines or telephones. This system can work well for large size transportation providers that can influence the use of their

fare media for other purposes. The agency may often work with other service providers but still retain control over the fare media. The original plans for the New York Metro Card with Chase Manhattan Bank utilized this system.

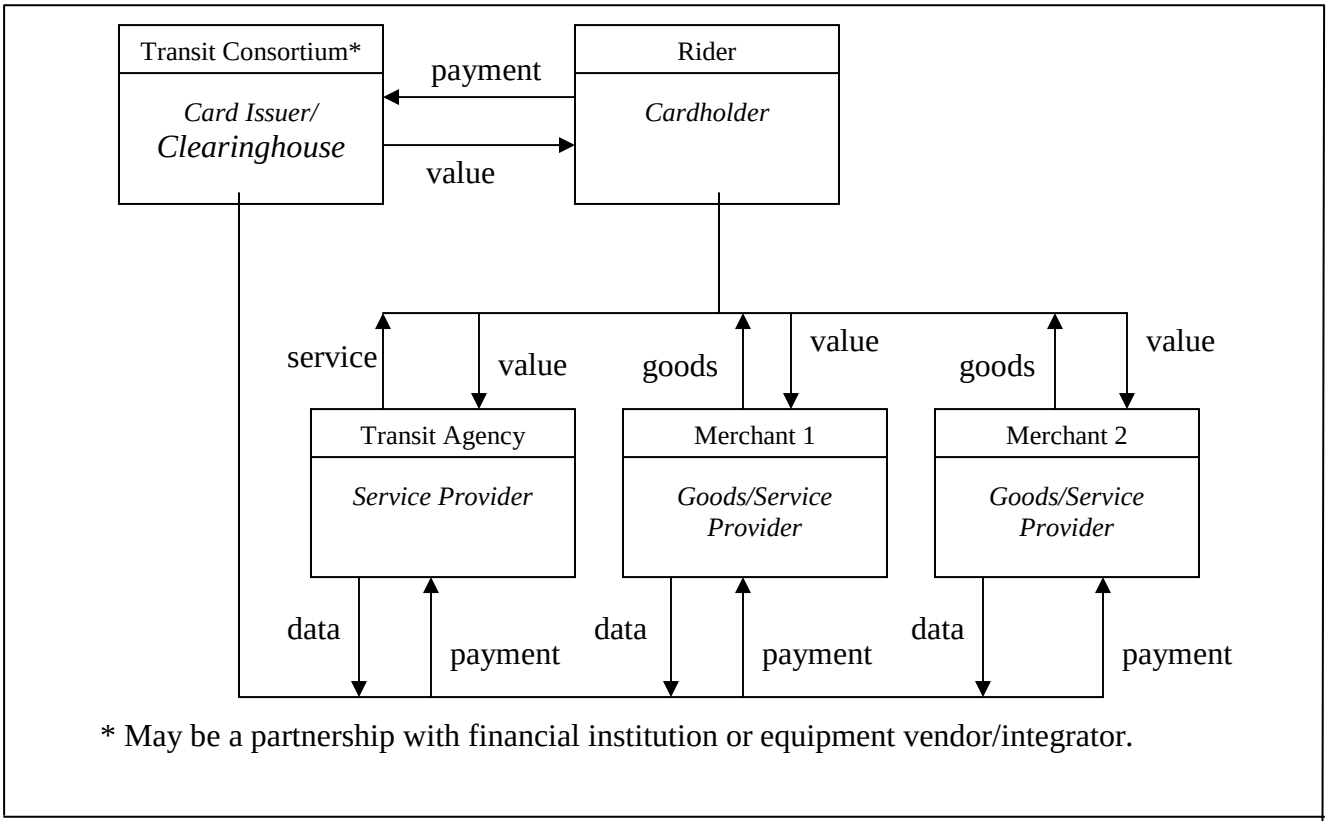

Figure 3 Closed Multipurpose Payment System (Source: 1998 TRCP Report 32)

3.3(b) Card Types

Card types can be contact, contact-less, magnetic stripe, or others as described below. As mentioned earlier, both contact and contact-less cards fall under the "smart card" technology (1,4).

3.3(b)(i) Contact: A contact card requires physical contact between the card and the read/write unit. The card must be inserted into a machine to operate and then be pulled out after use. The card contains a small array of electrical contacts on one surface for transmitting signals between the card and the base unit. The processing of necessary

information usually takes longer than the contact-less cards. The lengthy processing time is generally an impediment to its widespread use in public transportation.

3.3(b)(ii) Contact-less: A contact-less card does not have to be inserted into a machine. Instead, it has to be brought near a machine, the distance of which can vary between one to six inches. They are also referred to as proximity cards. There are several types of contact-less cards. They can be remote coupling, close coupling, or radio frequency. The differences in these are in the manner in which power is provided to the interface and data is transferred. Standards for contact-less cards are not currently as extensive as contact cards. However, there are efforts to standardize them. For public transportation purposes, a contact-less card is preferred. Because there are no moving parts, both fare collection equipment and maintenance costs are smaller in contact-less cards than in contact cards. The equipment is more reliable, riders have more convenience, and boarding time is reduced.

3.3(b)(iii) Magnetic Stripe: Magnetic stripe cards have been used in the past by transit agencies for stored value as well as for read-only prepaid purposes. A magnetic material that can be read and written by read-write units in computerized units is placed on the cards to act as a "storage area". Magnetic stripe cards are much cheaper to produce than any smart card technology, but they have several shortcomings. The equipment is more prone to failure, is less reliable, is slower, and has only limited capability to carry/transmit data. Some transit agencies that already have implemented magnetic stripe cards and that are currently updating to smart card technology, are still retaining the magnetic stripe feature, thus combining the payment forms to make the transition smoother.

3.3(b)(iv) Other: Besides the aforementioned card types, there are several others that can be used. A "capacitive card" is an inexpensive disposable memory card. The card needs no physical contact with a reader but must be inserted into a slot. The stored value information is in the form of laser-etched polyester film, not in magnetic or chip form. There also is a "combination card" that uses separate chips for contact and contact-less

interfaces. There are three combinations that exist, two-chip card, single chip with separate purse card, and single chip with single purse card. The purpose of the combination cards is to have both types (contact and contact-less) of functions available in one entity. These cards may be much more complicated than contact or contact-less cards and consequently are much more expensive to produce. Table 2 lists the three major card types with related properties.

Criterion	**Magnetic Stripe**	**Contact-less**	**Contact**
Convenience	Must be inserted or swiped	Very convenient; hold near target	Must be inserted
Privacy	Less of concern than with smart cards	Concern	Concern
Level of Security	Moderate	High	High
Time to board	Depends on format, but lower than smart cards	Highest	Lower than contact-less
Data Capacity	Lowest	High	High
Standardization	Standards exist	Being developed	Standards exist
Operating Experience	Considerable amount	No long term experience	Limited transit, but extensive non-transit experience
Unit Cost of Media	$.10 to $.60	$5 to $15	$2 to $10
Operating and Maintenance Cost Impact	Highest equipment and maintenance cost	Lowest equipment and maintenance cost; high life for cards	Longer life for cards than magnetic, low equipment and maintenance costs

Table 2 Characteristics of Card Technologies (Source: 1996 TCRP Report 10)

The environment and the card types to be chosen are highly dependent on the goals, needs, and capabilities of the specific transportation provider. Several key issues that the agency needs to consider before such decisions are made are:

- *What does the agency want to accomplish by changing its system?*
- *How much do they want to spend and how much funding is available?*

- *Are there other transportation providers in the region that also need to integrate new technology to have standards and interoperability?*

- *Is regional travel an issue?*

- *How will the new system be integrated into the existing system, considering factors such as time frame, trial period, amount of new equipment, education to public, operational and administrative?*

- *Is there going to be flexibility for future development?*

3.4 Issues

Disregarding the implementation of a new technology for fare collection include institutional, legal, and financial. Many of the issues overlap and sometimes depend on each other (1). These issues are discussed below.

3.4(a) Institutional

Institutional issues arise from the question of roles and responsibilities of the various entities who are involved in the design, installation, operation, maintenance and management of the fare collection system. The basic roles as defined in the Transit Cooperative Research Program (TCRP) Report 32 (1998) are as follows:

- **User:** Anyone who uses the payment media to purchase services or products from merchants.

- **Merchant:** An entity that will accept the media as payment for the provision of a service or a product.

- **Issuer:** An entity that provides the media and pays the merchants on the basis of the stored value they have received from users.

- **Distributor:** An entity that sells and provides recharge locations for the media and can include a bank ATM, a public transportation provider ticket vending

machine, a public transportation provider ticket agent, an outside vendor, or a participating merchant.

- **Acquirer:** An entity that obtains card transaction information from merchants and transmits it to the appropriate issuer; acquirers may not be needed in a closed system.

- **Clearinghouse:** An entity or organization responsible for managing many of the support functions for the multipurpose program, revenue management, customer service, and marketing.

These roles usually depend on the environment of the system and the entity that is initiating the new system, whether it is the transportation provider or a financial institution. The institutional approaches can be open, closed, or closed multipurpose, and the responsibilities may change accordingly. The institutional issues may further be related to the operational/administrative functions as discussed below.

Operational and administrative issues fall within the institutional arrangement. These issues are related to the running of the system on the management side including pricing, selling, and distributing the media. If several transportation providers enter into a regional system, each will probably want to retain its pricing structure and system. Additionally, how the subsidies for public transportation use are actually distributed is a question. There are a variety of ways to allocate fare. Such allocation can be based on a negotiated formula, survey data, actual ridership data, fixed percent, or geographic means. The type of card technology is also a factor.

An integrated fare program is one in which the payment media is universally accepted by all participating transportation providers. An integrated fare program may be used so that each agency is able to keep its own structure. Depending on the type of technology there are multiple ways in which the fare can be deducted appropriately reflecting accurate rider information.

Discounts and bonuses, as well as the sale and distribution medium, can get complicated when more than one agency is involved. Where to place the ticket vending machines or sales agents will be affected because of the tendency to place them in only high volume areas. Involving financial institutions also provides more distribution possibilities through branches and ATMs, but also limits those that do not utilize these entities. Other sale and distribution issues to consider are employer distribution programs, mail order sales, telephone sales, and internet sales.

3.4(b) Legal

There are several legal and regulatory issues that arise from the institutional, operational, and administrative arrangements. Factors such as privacy, Electronic Funds Transfer (EFT) regulations, authority of banks and non-banks to issue prepaid cards, and abandoned property and expired value may have to be considered in the appropriate legal context.

To date, privacy issues have not been a concern to public transportation providers. Information about riders is not typically maintained in any form either electronically or through cards. The new technology may allow, transportation providers to track and keep detailed information on individual riders. While there might be an added advantage from the point of view of collection and customer service application, many riders may see it as an invasion of their privacy. The agency in such cases must take appropriate steps to protect the privacy rights of its customers. In an open system this may become a significant issue because of the connection to banking information. In any form, privacy is an issue that riders may consider extremely significant; an issue that the agency must be sensitive to.

Electronic Funds Transfer (EFT) regulations refer to electronic fund transfers. The Federal Reserve Board is the appropriate regulating agency for EFT stipulations, and may be contacted for regulation E and Z concerning consumer protection, and “right to

know" information by the consumer. These regulations can be found on the National Archives and Records Administration web site. More specifically Regulation E establishes the rights, liabilities, and responsibilities of consumers who use electronic fund transfers. Currently, Regulation E does not appear to be immediately affecting stored-value programs. However, it may find its way into fare media because of the electronic nature of transactions that can take place with fare media technologies. Regulation Z is designed to promote the informed use of credit by consumers. Regulation Z would not be a problem unless credit cards were used to purchase prepaid cards. In such cases, the consumer and seller of the media would be subject to parts of Regulation Z, similar to other purchases with credit.

The authority of banks and non-banks to issue prepaid cards is in question. Non-bank entities in the context of fare cards may be indirectly engaging in banking functions without being a bank. In other words, whether the issuing of cards by the non-bank entity is perceived as "receiving deposit" has gone unchallenged.

Abandoned property and expired value have a great deal to do with stored value cards. Some states require unclaimed property to be given to the state. But in some cases public transportation providers have been exempt, and are hence allowed to keep the expired value. Also there are rights to the cardholder that must be addressed relative to refund of expired value.

Finally, responsibility for lost or stolen cards and equipment is also a legal issue that needs to be explored. There is currently no legislation on these issues and questions such as: "Who is responsible for lost or stolen cards?," "Who is responsible for malfunctioning cards and equipment?," and "Who is responsible for the value on cards if bankruptcy occurs?," will have to be resolved if the use of advanced technology for fare media is to be promoted at a higher level.

3.4(c) Financial

A final issue that is of significant concern to transportation providers is the funding aspect of new fare media. Depending on what and how many agencies enter into the new program, cost is probably the most important factor affecting the implementation of a new system. From TCRP Report 32, several key financial concerns are (1):

- *What are the capital and operating costs?*
- *Who will pay the cost for which items?*
- *What are the potential cost savings, new revenues, and other non-financial benefits?*
- *How are costs, benefits, and risks apportioned among participating entities?*
- *How can a multipurpose arrangement be structured financially so as to produce a "win-win" situation for all participating entities?*

There are several cost categories that need to be considered before implementing a new system. Many of the costs are dependent on the type of environment, the type of card technology, the status of the current system, and the level of usage.

3.4(c)(i) Operational and Maintenance Costs: Operating and maintenance costs should be reduced with the implementation of a new card technology. Ticket booth personnel and accounting personnel can be eliminated or minimized because of reduced processing time needed to operate the systems. Maintenance costs should be reduced with the use of contact-less cards because of the lower likelihood of equipment malfunctioning. However, as the equipment gets more sophisticated, the need for highly trained personnel increases. Maintenance costs could actually get higher if the current system has no technology in place. New operating and maintenance costs that may arise are in the areas of clearinghouse costs and new equipment costs.

3.4(c)(ii) Capital Costs: Capital costs include costs to procure and install fare media, fare collection and distribution equipment, and clearinghouse and communications equipment.

Fare media is highly dependent on the type of technology chosen. Smart cards cost significantly more than any magnetic or capacitive card. Equipment wise, card accepting devices, software, card vending machines, agency software, and a central data collection center are all specific to the type of technology used. Usually these costs are unique to each type of agency because of the tailoring of systems to the specific agency.

The range of financial costs depends on the current state of the agency and the type of system being implemented. Since any new system is customized for a specific transportation provider, cost is usually a factor that cannot be established without a set of established goals and needs.

4. AGENCY INTERVIEWS

4.1 Purpose

As part of this study, transportation providers from Michigan as well as from around the United States were contacted. The purpose of the interviews was to investigate transit agency knowledge of fare media technology, fare media technology's current use, and any future plans that agencies may have to implement new technology. As a need to further investigate Commuter Choice, local applications of the program were examined. Appendix A contains a list of the interviewed agencies.

Specific to Michigan, several agencies were contacted to assess their current use of fare media technology. These interviews were conducted through email and each questionnaire was somewhat tailored to the specific agency at hand based on previous knowledge about the agency. The results of these interviews are contained in Table 3. A sample letter is also contained in Appendix A.

Agency	Fare Media Technology
1. AATA (Ann Arbor Transportation Authority)	Currently use GFI Recording fare boxes that accept cash in the form of coins and bills. Drivers record flash passes with a keypad on the fare box.
2. SMART (Suburban Mobility Authority for Regional Transportation)	Currently use GFI Genfare fare boxes that accept cash and magnetic stripe cards. SMART uses regional monthly passes that are accepted by the Detroit Department of Transportation (DDOT) without paying a transfer fee. SMART is in the process of installing Ticket Reading and Issuing Machine (TRiM) units from GFI which will be able to read and write paper magnetic tickets. With this technology, SMART will be able to have rolling day passes from first use, stored value, and multi ride cards.

Table 3 Michigan Transit Agency Interview Results

Agency	Fare Media Technology
3. DDOT (Detroit Department of Transportation)	Currently use GFI fare boxes that accept cash and magnetic stripe cards. DDOT accepts a regional monthly pass issued by SMART. DDOT is also in the process of implementing rolling day passes (magnetic stripe) from the point of sale. It has no immediate plans to add TRiM units.
4. Flint MTA (Flint Mass Transportation Authority)	Currently uses GFI fare boxes with TRiM units and Coincard, which is a smart card and film card reader. On peak routes there are Chicago fare box (mechanical) and Coincard.
5. JTA (Jackson Transportation Authority)	Currently uses mechanical cash drop boxes.
6. CATA (Capital Area Transportation Authority)	Currently uses electronic fare boxes on fixed route buses and have mechanical fare boxes on rural services along with SpecTran (for persons with disabilities).
7. Bay Metro (Bay Metropolitan Transportation Authority)	Currently have Duncan Industries Acceptafare and a few old "Main" fare boxes. Both take cash only. Flash passes are also used.
8. Blue Water Area Transportation	Currently uses Diamond mechanical fare boxes.
9. Muskegon Area Transit System	Currently have cash drop boxes and flash passes.
10. ITP – *The Rapid* (Interurban Transit Partnership)	Currently uses Duncan cash drop boxes and flash passes.
11. Macatawa Area Express (Holland)	Currently uses Main fare boxes, the treasury model, which is a manually operated cash drop box.
12. LETS (Livingston Essential Transportation Service)	Currently uses cash drop boxes.
13. Kalamazoo Metro Transit System	Currently uses GFI Genfare fare boxes that accept only cash.
14. STARS (Saginaw Transit Authority Regional Services)	Currently uses Diamond fare boxes that accept cash and tokens.

Table 3 Michigan Transit Agency Interview Results (Continued)

4.1(a) Agencies With Existing Fare Media Technology

The results from these interviews varied greatly depending on the size and location of the transportation provider. Many of the agencies did have some type of technology already incorporated into their systems or were in the planning stages to advance their equipment. All of the agencies viewed it as necessary to continue advancing towards fare integration efforts with surrounding agencies to provide better service for their riders and increase use of public transportation.

4.1(b) Fare Media and Equipment Vendors

Besides contacting transit agencies, vendors of fare media equipment were also contacted. During the initial interviewing of transit agencies and through the literature review, it was discovered that there are only a few vendors throughout the United States. In Michigan, it is further narrowed to one vendor, GFI, supplying almost all of the fare media equipment to the agencies. For this reason, GFI was contacted for pricing information as a basis for evaluating equipment modifications or upgrades to achieve compatibility with fare media technology between multiple providers. Results from the GFI interview are detailed in the next section.

4.1(c) Michigan Applications

Through the interviews with Michigan public transportation providers it was discovered that the regional agency, Suburban Mobility Authority for Regional Transportation (SMART), located in southeast Michigan, is the only agency that had implemented a broad based Commuter Choice Program via a voucher program known as TransitChek. SMART has also made efforts to coordinate its TransitChek program with the local transit agency, the Detroit Department of Transportation (DDOT).

The SMART TransitChek program began in 1993. It currently has approximately 40 employers enrolled throughout southeastern Michigan. Sales from this program average $10,000 a month. Vouchers, strip tickets, park and ride passes, SMART Monthly passes, and SMART/DDOT Regional passes are available options to employers and employees.

While SMART's program may be the only one of this type in Michigan, its success over the past eight years has proven that there is a market and a need for Commuter Choice applications in Michigan. Creative steps taken by the agency may take advantage of the market, while serving this critical need. Also, by examining the sales of the type of fare media used by SMART it can be seen that the SMART/DDOT Regional pass, which allows the use of both DDOT and SMART services, has the second highest sales numbers. The vouchers have the highest amount of sales. The large amount of regional passes may be an indication of the inter-agency travel that riders utilize, and thus a potential for growth with other agencies. Appendix A contains further detail of sales for 2001.

It is felt that the program developed by SMART, in conjunction with DDOT, could serve as a "blueprint" for other regional agencies to partner with local agencies and major employers to develop such programs elsewhere in the state and in the nation.

5. FARE TECHNOLOGY COST ANALYSIS

There will be various capital and operating costs associated with implementing any new fare technology as a means for fare integration. The cost elements associated with developing, implementing and administrating a fare integration program will depend on the existing fare structure, fare media, fare equipment, and any institutional arrangements. Many other variables exist that will also affect the choices of technologies, but these can only be resolved after the goals of the fare integration effort are complete. Possible cost elements for a transportation provider include the following:

- Card-accepting devices
- Electronic registering fare box
- Mechanical fare box
- Ticket processing unit (magnetic) (TPU)
- On-board probe equipment
- Garage hardware/software
- Central hardware/software
- Card vending machine
- Maintenance and repair

When examining costs for fare integration programs, two different approaches can be developed. The first is for all agencies to incorporate a new system with all the same components. This will essentially create one unified system that operates with the same technology. The second is to upgrade each agency's system to be compatible with each other. This undertaking is somewhat more difficult because of the variability in technology that exists between agencies. It will also result in different costs for different agencies.

5.1 New Systems

For agencies that do not have electronic fare boxes, but only have cash drop boxes, they must purchase a complete new system. In Table 4, the unit cost range for each item to be purchased as a complete new system is represented. The dollar amounts provided are estimates based upon information provided by the vendors.

The possible fare box items include: the GFI TRiM (for lower cost), the GFI CENTSaBILL (for middle cost), and the Odyssey (for higher cost). The GFI TRiM is a ticket reader/issue machine, which is a self-contained unit that issues/receives printed and magnetically encoded transfers, receipts, tickets, or passes. The GFI CENTSaBILL is an electronic registering fare box, which assures rapid collection of any combination of fare media an agency uses: coins, dollar bills, tokens, tickets, and magnetically encoded documents. The Odyssey is an electronic revenue center, which is the latest fare collection unit that has features such as: interface to smart bus systems and advanced driver and passenger displays. Additionally, it issues and validates magnetic transfers, processes magnetic stripe documents, provides electronic change, validates coins and bills, and accepts credit cards.

The magnetic software is designed to configure the Ticket Processing Unit (TPU) for the types of passes/transfers/etc., and the parameters to be used in the system. The lower cost includes the read only and the higher cost has the read/write component.

The garage data system consists of: Pentium computer, 3 ½" floppy disk drive, 15" color monitor, keyboard, HP laserjet 6P printer, UPS, backup tape drive, modem, miscellaneous GFI Genfare equipment and hardware (probe, cable, isolation box, junction box, etc.) as necessary for single service probing lane. The lower cost model includes GFI Version 7 software and training and the higher cost model includes GFI Version 7A software.

The vaulting equipment is a stationary revenue collection system, which uses a receiver, outer structure, and currency bin. The options for vault assembly are through the wall, through the wall with cashbox ID computer and software, and mobile vault with cashbox ID computer and software.

The magnetic cards could be magnetic polyester or thermal polyester. The card includes the encoding, printing, and design development for the passes that include monthly, weekly, adult, senior, 10 rides, etc. The price is based on a quantity of 100,000 cards without restriction on type of card. Transfers consist of thermal coated, magnetic striped paper transfers; each unit includes 100,000 transfers.

Cost Element	Unit Cost (Range)
Fare box	$3,450-10,600
Magnetic Software	$800-2600
Fare box Equipment Installation	$550
Garage Data System	$35,000-35,500
Portable Electronic Key	$850
Vaulting Equipment	$25,000-30,000
Magnetic Cards	$25,000
Transfers	$1,800
Central Software	$18,500-19,000
Spare Parts	10% of equipment

Table 4 Cost Estimates for New Systems (GFI)

5.2 Upgrading Systems

For agencies that already have an electronic fare box, an upgrade to the current fare boxes may be an alternative. Table 5 is the unit cost range for each item in upgrading a system. The data collection system upgrade includes: Pentium III, 733 MHz processor computer with 1.44 MB floppy disk drive, 40X CDROM drive, 13.5 GB hard drive, 128 meg RDRAM, 15” color monitor, Matrox Millenium G400-SG AGP video, Intel PRO/100+ Management Adapter Controller, Compaq 10/20 GB Travan TR-5 tape drive, APC Smartups UPS, HP Laser Jet 6P printer, modem, windows NT 4.0, and all

GFI version 7A windows based software including testing, training, and documentation. Magnetic cards, transfers, and central software are the same as the description above.

Cost Element	Unit Cost (Range)
Fare box	$875-1,800
Fare box Equipment Installation	$1,950
Data Collection System Upgrade	$23,500
Vaulting Reconditioning	$2,000
Magnetic Cards	$25,000
Transfers	$1,800
Central Software	$19,500
Spare Parts	10% of equipment

Table 5 Cost Estimates for Upgrading a System (GFI)

The given prices are for one fare box. The prices do decrease based on quantity. The quantity ranges are 1-25 units, 26-100 units, 101-250 units, and 250+ units.

6. GUIDELINES FOR FARE INTEGRATION

Coordination between participating agencies is considered a key factor for developing a "seamless" travel experience for customers using multiple service providers to reach their final destination. Coordination is also a key factor for employers when evaluating the implementation of a Commuter Choice Program. If technology is going to bring about these efforts, there must be careful collaboration between agencies, because not all fare media, fare media equipment, and software are compatible with each other. Furthermore, the administrative end of the system needs just as much attention as the operation end, when dealing with new fare structures and policies. The specific actions of the parties involved will vary depending on the settings and details of each organization, but several basic steps should still be followed as discussed below and outlined in Figure 4. (5,6,18)

6.1 Getting Started

A stakeholder workshop that identifies participating agencies and their specific interests should take place first. A stakeholder in this case is defined as an agency whose participation will either affect the success of the proposed system, or whose performance may be affected by the implementation of the new system. Agencies that are part of a current regional system or who could be affected by current or future fare integration should participate in the workshop. Identification of other stakeholders such as employers, financial institutions, colleges or universities, and human service agencies should be considered.

All participating agencies should develop an understanding of the benefits of the new system as well as associated risks and uncertainties. Agencies required to invest capital should be aware of the trade-offs between potential gains and associated risks and be willing to make necessary organizational changes. Cost-benefit analysis, rider surveys, and agency surveys are all viable ways to measure these. Depending on the specific technology chosen to facilitate the regional travel effort, there are a wide range of benefits. Table 6 lists some benefits.

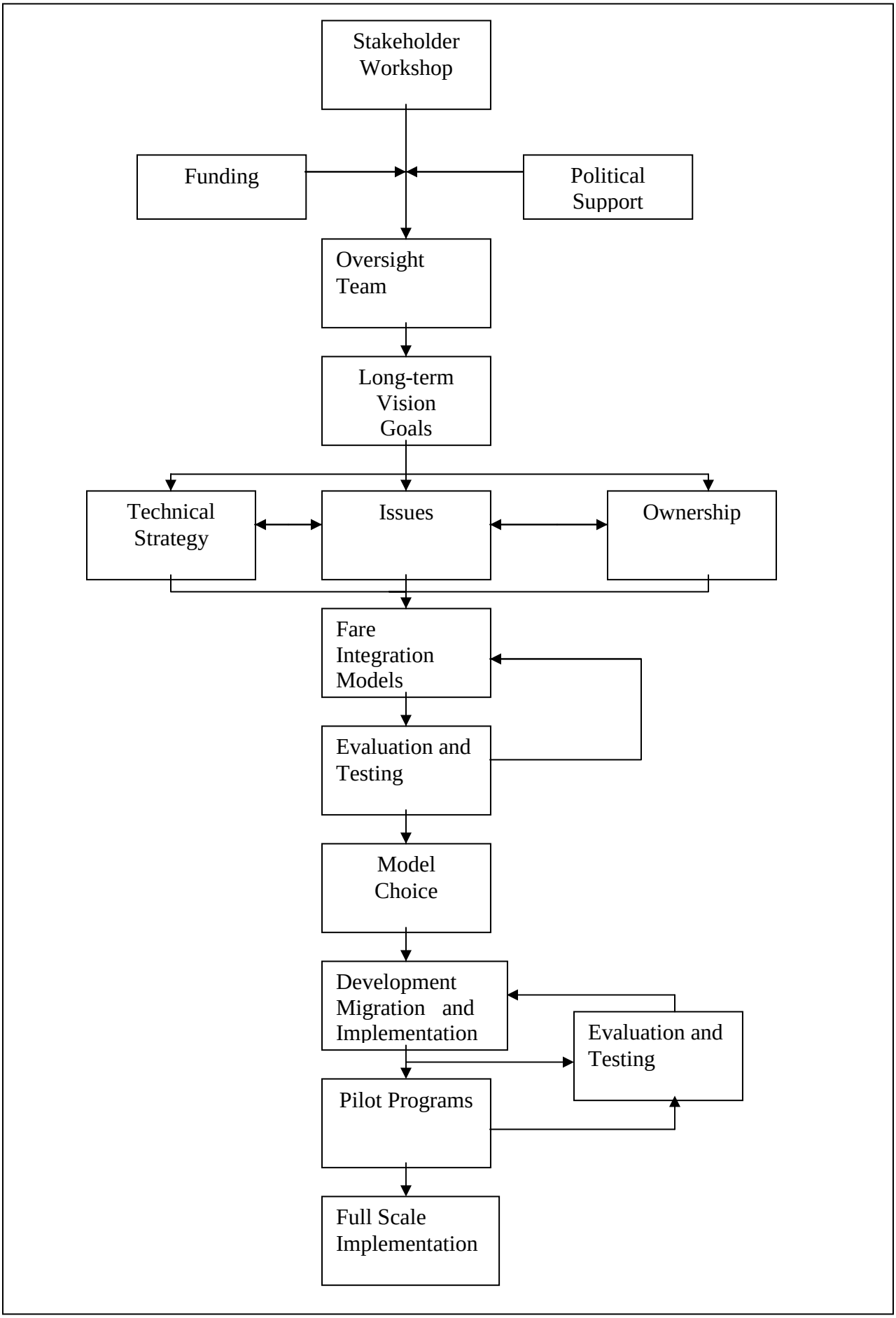

Figure 4 Fare Integration Flow Chart

1. “Seamless” travel for riders that use more than one transportation provider for a trip.
2. Consolidated fare structure and fare policy.
3. Convenience for riders.
4. Increased ridership.
5. New ridership markets.
6. Possibilities for third party relationships with employers, financial institutions, colleges, universities, and human service agencies.
7. Improved operating efficiency.
8. Possibilities for reduced operating and maintenance costs.
9. Improved data and reporting capabilities.

Table 6 Fare Integration Benefits

Discussions of other coordination experiences, statewide, nationally, or possibly globally will provide real examples of systems that are working. Other agency representatives who may have successfully implemented such systems could come to speak about their systems. They could provide suggestions on what to do and what not to do. The participating agencies should develop a familiarity of language associated with regional travel and technology, and may be able to update their knowledge base through a review of the current literature. Each agency should be able to discuss issues on a common ground such that their roles and responsibilities are clearly defined, with little or no ambiguity.

A discussion should take place on whether or not there is a market and if such a market is likely to change (either upward or downward) in the near future. Rider market research may be a way to evaluate the needs of regional travel and fare integration for the area. As indicated earlier, coordination and participation are the two most crucial

components for successful fare integration or regional travel. Planning for future endeavors may be undertaken depending upon the magnitude and type of need.

6.2 Funding

The stakeholders should next begin to identify and establish funding requirements and mechanisms. A review of possible funding availability will determine where future support may occur. While the specific technical and administrative costs may not be known at this time, the resources and channels of funding need to be explored. If more specific cost elements are needed, a group should be designated to investigate and estimate initial costs for different levels of planning scenarios.

6.3 Political Support

It is recommended that the stakeholders begin to work with state and/or local government officials to gain the support needed by each agency. Agencies should secure adequate resources to make the effort worthwhile. Once targets and objectives are in place along with a long term vision, all stakeholders should have a clear understanding of what the fare integration effort will do to promote a seamless travel environment for its customers.

Local opportunities should also be examined and evaluated for support. For example, the possibility of participation in a regional effort by other private/not for profit travel agencies, universities, and financial institutions should be explored.

6.4 Stakeholder Collaboration

An oversight team should be formed that includes representation from all stakeholders. An organization that is already established could take on this responsibility with representation of all participating agencies. Establishing priorities and a timeline for

the project in conjunction with the participating agencies must be accomplished first. The oversight team will facilitate the project in many respects as discussed below.

6.4(a) Long-Term Vision

One of the most important functions of the oversight team is to establish a long-term vision that will be the driving force behind the success of the effort. The long-term vision should be for a period of five years or more. The establishment of such a vision will allow long-term planning strategies and implementation to work much more effectively. Some possible features of a long-term vision could include:

- Retaining agency autonomy even after a new regional fare structure, policy and media are implemented
- Support for coordinated incentive programs
- Partnerships that enhance customer convenience
- Potential future technological enhancements

Part of an example from the California Department of Transportation (Caltrans) vision regarding smart card technology and regional travel is as follows:

> "Our vision is to support a seamless interoperatable transportation payment infrastructure of all transportation modes, not be limited by institutional constraints, or the absence of interregional, interoperatable payment systems, in the development of transportation payment products. Caltrans feels that it is in the best interest of the state to have established standards that will facilitate the seamless, safe and efficient movement of people and goods within, and through the state."
> (*Source: http://www.dot.ca.gov*)

6.4(b) Objectives and Measurements

The oversight team must also agree upon common objectives or goals, and target levels of performance to meet those objectives. The objectives should enhance the long-term vision. Figure 5 is an example of system goals established by the Puget Sound

regional operators (Seattle) for their Regional Fare Coordination System. Objectives will ultimately be used to evaluate and analyze the fare policies and procedures, fare technology, required services and implementation strategy options that arise. The targets should be measurable units that all the agencies concur with and should be tested against industry standards.

1. The ability to introduce a single fare medium and common seamless fare collection system for the region.
2. The ability to use pricing strategies to target specific customers, transit services, or ridership behaviors.
3. The ability to establish innovative pass agreements with employer, commercial, campus, or human service accounts to provide subsidized access to public transportation for their constituents.
4. Accurate ridership and revenue data to plan, report, and evaluate service and the effect of marketing and pricing strategies.
5. Improved agency business practices, which enable the redistribution of support staff efforts behind the scenes to direct customer service.

Figure 5 Regional Fare Coordination System Goals (Source: Federal Transit Administration, "National Transit Smart Card Guidelines-Module 4 Employer Programs")

6.4(c) Fund Management and Distribution

The oversight team should be responsible for or should oversee the fiscal management for the effort. Appropriate methods must be developed for pooling funding and distributing it to the proper agencies. After initial investigation, different procurement methods may be proposed that will affect funding. For example, each agency may select its own technology. This may lead to increased costs needed to bring about a collaborative system with other agencies because of the lack of coordination. On the other hand, the agencies can agree upon a technology standard and either procure it

themselves or jointly with other agencies. This may affect funding because if a decision is made to not collaborate, then each agency is responsible for its own systems.

6.4(d) Technical Oversight

The oversight team will appoint a technical committee to develop details of technical requirements and options for joint operation. The committee will be responsible for determining the current status of all agencies and recognizing any commonalities or differences that exist. This process will help develop a baseline or common starting ground for the technical aspects of the effort. The technical committee should also begin efforts to gain access to additional technical resources, other transit agency technical experts, industry experts, or academic experts.

The technical requirements of any particular system are highly dependent on the goals for the coordinated service and current status of the participating agencies. The wide range of available fare media makes a multitude of options viable.

When dealing with the technical requirements, several system architecture components must be defined and established for the region. These components may include the fare payment system, fare distribution system, and clearinghouse processing system.

6.4(e) Fare Payment and Distribution System

The fare payment system should clearly define how the system is to be setup to receive the fare media and to check the validity for a ride. The three types of fare payment structures, monetary value, stored rides, and time based pass, all need to be considered. If different agencies have different structures, the fare payment system infrastructure must be able to accommodate such differences. This also depends on the type of fare media selected because different media can support a variety of fare payment structures on one card. Variability can be avoided if throughout the region, the different

agencies agree upon a common fare structure. A system with a minimum amount of variability across different agencies is highly desirable. However, practical constraints may sometimes impose unavoidable variabilities.

The fare distribution system is the infrastructure for physically distributing the fare media as well as reassigning an appropriate value to a fare media. Distribution can occur in many forms such as a customer service terminal (attended), a stand-alone machine (if the fare media warrants it), third party sales, or mail order sales. Reassigning values to cards can likewise be at service terminals (attended), stand-alone machines, or on the vehicle itself. A few options to consider for fare distribution systems are the current status of distribution among the agencies and a set of guidelines on how to link together payment forms accepted for fare media (cash, check, credit cards, etc…).

6.4(f) Clearinghouse Processing System

Clearinghouse processing systems are really the backbone for public transportation systems serving employers and thus the Commuter Choice Program. This involves capturing and processing of data and fare payments along with their distribution throughout the region. Depending on the fare media, fare payment structure, and fare distribution, the clearinghouse will have a variety of functions associated with it. For example, if a smart card with different purses for each separate agency exists, the clearinghouse must be able to allocate the funds in an appropriate manner. It must also be able to add value to each purse and reconcile funds when the card is used. For a simpler system with a magnetic (stored value) card, the clearinghouse would only have to reconcile the funds when the card is used. Depending upon the organizational complexity of the agency that is responsible for operating the clearinghouse, it may have to provide an endless array of functions. Current options for running the clearinghouse include the agencies themselves (alone or together if resources are available), private third party, or a joint public/private effort.

Depending on the technology chosen, revenue is either allocated by a negotiated formula among the transit agencies, through survey data, through actual ride data, by a specified percent, or through geographic means. For example, in Ottawa, Canada, two transit agencies that share a regional system, allocate the revenue through geographic means. That is, riders must purchase a pass in their province and hence, the system must ensure that the money is at the appropriate place. In Seattle, Washington, the regional system is set up by the seven counties using a predetermined formula to allocate revenue between agencies that was derived from historical ridership data. In Detroit, Michigan, two agencies (SMART and DDOT) have an agreement to split evenly the sales for a regional pass.

6.4(g) Card Reader Compatibility

Concurrent with the selection of the previously mentioned infrastructures, are the card technologies and reading unit technology requirements. Reading unit technologies are just as variable as the card technologies. Most manufacturers can customize any type of reading unit that a transit agency might specify. A few of the simpler ones are the magnetic stripe readers and mechanical drop box collectors. More complicated ones include magnetic stripe read/write units, mechanical drop box collectors/bill validators, pass and go readers, or any smart card readers. Combinations of readers are also available and in most instances transit agencies may retain their old collection system while adding newer technologies.

6.5 Issues

Specific categories of deployment issues and challenges for which collaborative decisions will be required must be determined. Such issues could potentially involve institutional, operational, administrative, legal, and financial constraints associated with regional travel. The issues can be complicated because of the different environments many transportation providers operate under, administratively, operationally, technically and otherwise.

These issues eventually need to be dealt with by the oversight team. The oversight team may not have in place answers to all of the issues, but through its findings it may be able to identify possible solutions to the issues and provide suggestions for operation of a fare integration effort. In this sense, the efforts should be objective driven. That is, what the agencies decide upon, as their objectives of regional travel should be supported by the technical and administrative options that they have available. Alternatively, the fare integration effort may be technology or administratively driven where the agencies work on resolving the issues after the system is selected for implementation. Both of these possibilities are viable in their own respect and likely to work well under the right circumstances.

6.6 Initial Deployment

Development and selection of appropriate regional travel models by the oversight team should take place. The models should be structured to satisfy the objectives that were established by the oversight team as well as to identify how these objectives can be met. Any potential issues that may have risen from the oversight team should also be resolved. Ultimately, operating agreements should be developed that identify and define shared services in the system, define roles and responsibilities for the new system, define fare policies and structures, and specify all technical requirements for the agencies. Future capabilities of the integrated fare system should also be examined. Long-term planning and how each model provides support for the long-term vision must be examined. A fare integration model that is only appropriate for current conditions, but is incapable of incorporating future developments should be avoided. Likewise, a regional plan that appears to work well in recognizing future growth patterns, but is incapable of incorporating current conditions, should not be used. Every aspect of the integrated fare system should be complete.

A systems analysis should also be done by each agency to identify any departments or processes that may be affected by the fare integration models chosen as

options. If there are substantial changes, or if the changes cannot be accommodated by the agencies, a revision of the original goals may need to take place or a different fare integration model developed.

6.7 Migration Path and Implementation Program

The migration path needs to identify the sequencing of specific implementation efforts once a final fare integration model has been chosen. A timeline of the program implementation should be developed based upon the complexity of the system. A complete implementation program can then be developed. The implementation plan should address:

- In what order will the system be implemented?
- What training and development steps need to be taken?
- How will the implementation be managed?
- Who will manage the implementation?

6.8 Recommendation

The development of a fare integration program is a very complex undertaking. It takes tremendous planning and, depending on scope, can take years to research, test, and implement. Therefore, use of a pilot or demonstration program is a good way to test the new system and check for possible improvements. The new system should be monitored and measured against the standards that have been created. From rider surveys, identification of appropriate market segments for the pilot programs can take place. Such categories as travel behavior impacts, management and operational impacts, financial impacts and institutional impacts can be analyzed. Showing measurable benefits as early as possible will help the overall strategy of the implementation program. Data from pilot programs can then be used to change certain aspects of the program before full-scale launch.

7. CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to conduct a review of the emerging fare-media technologies, and to explore how these technologies can be used to promote the Commuter Choice program in Michigan to the mutual advantage of employees, employers and transportation providers. A secondary purpose was to assess the extent and manner in which Michigan transit agencies have, so far, deployed these emerging technologies and have implemented the Commuter Choice program. As a part of this study, an extensive review of the current literature on fare media technologies was conducted and interviews were held with selected transportation providers in Michigan, as well as those out of state. A set of sample interviews were also held with selected vendors. Specific conclusions of this study are as follows:

7.1 Environment

The environment within which the fare media is likely to operate is considered equally important as the technology itself. Three types of environments exist: open, closed and closed multipurpose. While most transportation providers have in the past operated in a closed system, large-scale systems are currently exploring the open system for the amenities they offer.

7.2 Card Types

Card types may be contact, contact-less, magnetic stripe and others. The environment and the card types to be chosen are highly dependent on the goals, needs, and capabilities of the specific transportation provider. Factors to be considered are costs, need for interoperability with other transportation providers, regional travel, need for flexibility, and others. Compatibility between card types and environment is considered a crucial factor.

7.3 Fare Media Technologies in Michigan

A majority of the Michigan transit agencies that have implemented some type of fare media technologies have used the same vendor, GFI. GFI supplies fare boxes and fare equipment for many of the transit agencies. However, there are varying degrees of technological capabilities (ranging from cash drop boxes to magnetic stripe cards) with the equipment within the state. This is because of the varying degree of service that the agencies provide, from large urban areas to small rural areas. The possibility exists to combine fare media using various technologies, however, such combinations may not prove cost effective for smaller agencies.

7.4 Institutional, Legal, and Financial Issues

A set of institutional, legal and financial factors should be considered by the transportation provider before the implementation of any type of fare media. Institutional issues arise from the question of roles and responsibilities of the various entities that are involved in the design, installation, operation, maintenance and management of the fare collection system. Factors such as privacy, Electronic Funds Transfer, and authority of banks and non-banks to issue prepaid cards should be considered in the appropriate legal context. Financial issues encompass capital, operating, and maintenance costs. These costs are largely dependent on the type of environment, the type of proposed technology, status of the current technology, and the level of use.

7.5 Seamless Travel

Promoting travel in a seamless manner is generally one of the goals of implementing new fare media technology. However, seamless travel can be attained without any new fare media technology, provided proper fare integration arrangements are made between agencies.

7.6 Commuter Choice

The federally supported Commuter Choice program is considered by many transit experts as an effective tool to promote greater utilization of public transportation and vanpools for commute to work through certain tax benefits to employees/employers. This can be accomplished either through prepaid fare media, such as passes or tickets, or through vouchers, currently up to $100 per employee, for each calendar month of eligible tax benefits.

In spite of the tax advantages for employees in the Commuter Choice Programs, transportation providers are likely to face several barriers in implementing such a program in cooperation with major employers in the region. These include difficulties encountered in dealing with employees with multiple locations, incompatibility between technology and administration involving multiple agencies, difficulties in the distribution of fare media involving multiple providers (particularly if separated by significant distances), and the inability of the agency/agencies to provide a wide array of fare media options because of resource limitations.

The key to the success of the Commuter Choice Program lies in the willingness of the employers to participate in the program and the ability of the agency/agencies to design a program that is responsive to the needs of the employers. Other factors likely to contribute to the success of such a program include: collaboration between providers, use of uniform vouchers/passes as warranted, and fare integration between providers.

In Michigan, the regional transit agency SMART has implemented a successful Commuter Choice Program. The program, which started in 1993, has approximately 40 employers enrolled and generates approximately $10,000 of ticket sales per month. It is felt that the program developed by SMART, termed TransitChek, may be used as a “blueprint” by other regional agencies to partner with local agencies and employers elsewhere in the state.

7.7 Fare Integration

Coordination between participating agencies for fare integration is considered a key factor in developing a seamless travel experience for customers using multiple service providers to reach their final destination. Benefits for such fare integration include: increased ridership, convenience for riders, new ridership markets, improved operating efficiency, and reduced operating costs. A set of guidelines for fare integration was presented in this report that included such items as identifying stakeholders, developing an oversight team, developing a long-term vision, identifying funding sources, and garnering political support. The use of pilot demonstration programs is considered a good way to test a new system, identify pitfalls, and propose improvements. The new system should be monitored and measured against established standards.

8. ACKNOWLEDGEMENT

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9. LIST OF REFERENCES

1. Transit Cooperative Research Program (TCRP) Report 32, "Multipurpose Transit Payment Media", Daniel Fleishman, Carol Schweiger, David Lott, and George Pierlott; National Academy Press, Washington, D.C. 1998.

2. Transit Cooperative Research Program (TCRP) Report 10, "Fare Polices, Structures, and Technologies", Daniel Fleishman, Nicola Shaw, Asok Joshi, Richard Freeze, and Richard Oramj, National Academy Press, Washington, D.C. 1996.

3. http://www.dot.ca.gov

4. http://www.fta.dot.gov

5. "Regional Payment Partnership Action Plan", Volpe National Transportation Systems Center and Mulitsystems, VDOT, September 25, 2000.

6. "Regional Payment Partnership Action Plan-Executive Summary", Volpe National Transportation Systems Center and Mulitsystems, VDOT, September 25, 2000.

7. http://www.itsa.org

8. http://www.apta.com

9. http://www.gfigenfare.com

10. http://www.smartcardalliance.org

11. http://www.cubic.com

12. http://www.goventura.org

13. http://www.soundtransit.org

14. http://www.wmata.com

15. "Token-less MBTA system may be on horizon – again", Thomas C. Palmer, Boston Globe online, htttp://www.boston.com, June 24, 2001.

16. Transit Cooperative Research Program (TCRP) Report 14, "Institutional Barriers to Intermodal Transportation Policies and Planning in Metropolitan Areas," Crain and Associates, Inc. and Pacific Consulting Group; National Academy Press, Washington, D.C., 1996.

17. 2001 Sound Transit On Board Survey, Central Puget Sound Regional Transit Authority, Northwest Research Group, Inc.

18. Federal Transit Administration, "National Transit Smart Card Guidelines-Module 4 Employer Programs," Volpe National Transportation System Center and IBI Group, April 14, 1999.

19. Clean Air Transportation Communities Grant Application, prepared by Michigan Department of Transportation-Passenger Transportation Division.

20. TransitChek program employer packet, Surburban Mobility Authority for Regional Transportation (SMART).

21. http://www.scia.org

Appendix ‘A’

Listing of Transit Agencies Interviewed			
Agency	**Person**	**Method**	**Date**
DDOT	Leon Martin, Maintenance Supervisor	In person	7/23/01, 7/30/01
SMART	Dennis Ellis	Phone	7/23/01, 7/30/01
SMART	Melissa Hightower	In person	10/23/01
LETS	Catrina Maxwell	Phone	7/23/01
CATA	Matt Vandlen, Maintenance Supervisor	Phone	7/30/01
MTA	Leonard Wilson, Maintenance Supervisor	Phone	8/1/01
Bay Metro	Doug Gasta, Maintenance Supervisor	Phone	8/13/01
Muskegon Area Transit System	Fredrick Smith, Senior Supervisor	Phone	8/13/01
The Rapid	Kim Stoddard, Maintenance Administrator	Phone	8/15/01
Bay Metro	Eric Sprauge, Planning Supervisor	Phone	8/15/01
Out of State Agencies			
Agency	**Person**	**Method**	**Date**
King County Metro (Washington)	Candace Carlson	email	7/30/01
Sound Transit	Tony Fuentes	Phone and email	8/27/01
Ventura County	Vic Kamhi	Phone	9/6/01
WMATA	Bob Stedman, Transit Analyst	Phone	9/6/01
OC Transpo (Ottowa)	Pat Scrimgeour, Program Manager	Phone	9/11/01
Other			
Agency	**Person**	**Method**	**Date**
GFI	Larry Adukiewicv	Phone	8/13/01
GFI	Toulla Constantinou	Phone, email	10/9/01 10/11/01
GFI	Roy Purnell	Phone, email	10/11/01

Table 1A Listing of Transit Agencies Interviewed

To whom it may concern:

Hi, my name is Joseph Bartus and I am working on a research study for MDOT through Wayne State University in Detroit. The purpose of the study is to determine the feasibility of regional travel between different agencies with one fare media. Fare boxes and software seem to be one of the determining factors. If you could please tell me what type (brand) of fare boxes you have and their operation type, for example mechanical drop box, magnetic reader or writer, flash pass, etc…) it would be a great help. If you cannot answer this could you please forward it to the appropriate person. Thank you very much for your time.
Sincerely
Joseph Bartus
Joewsu@hotmail.com

Figure 1A Sample Letter Sent to Michigan Transit Agencies

This letter was used as part of the inventory for Michigan transit agencies. It was sent via email to and responded by the following agencies:

Flint MTA

Grand Rapids- The Rapid

Capital Area Transit Authority

Bay Metro Transit

Macatawa Area Express

Muskegon Area Transit System

Jackson Transit Authority

Blue Water Transportation Commission

Ann Arbor Transit Authority

January-01	**$1.50 Smart Card ($47.00)**	**SMART/DDOT Regional Pass ($49.50)**	**SMART Park & Ride ($66.00)**	**Strip Tickets ($1.50)**	**Strip Tickets ($2.00)**
Totals	3	62	5	0	0
February-01	**$1.50 Smart Card ($47.00)**	**SMART/DDOT Regional Pass ($49.50)**	**SMART Park & Ride ($66.00)**	**Strip Tickets ($1.50)**	**Strip Tickets ($2.00)**
Totals	3	65	5	0	0
March-01	**$1.50 Smart Card ($47.00)**	**SMART/DDOT Regional Pass ($49.50)**	**SMART Park & Ride ($66.00)**	**Strip Tickets ($1.50)**	**Strip Tickets ($2.00)**
Totals	4	68	5	0	0
April-01	**$1.50 Smart Card ($47.00)**	**SMART/DDOT Regional Pass ($49.50)**	**SMART Park & Ride ($66.00)**	**Strip Tickets ($1.50)**	**Strip Tickets ($2.00)**
Totals	4	66	5	0	0
May-01	**$1.50 Smart Card ($47.00)**	**SMART/DDOT Regional Pass ($49.50)**	**SMART Park & Ride ($66.00)**	**Strip Tickets ($1.50)**	**Strip Tickets ($2.00)**
Totals	4	0	5	0	0
June-01	**$1.50 Smart Card ($47.00)**	**SMART/DDOT Regional Pass ($49.50)**	**SMART Park & Ride ($66.00)**	**Strip Tickets ($1.50)**	**Strip Tickets ($2.00)**
Totals	0	8	1	0	0
July-01	**$1.50 Smart Card ($47.00)**	**SMART/DDOT Regional Pass ($49.50)**	**SMART Park & Ride ($66.00)**	**Strip Tickets ($1.50)**	**Strip Tickets ($2.00)**
Totals	0	60	1	0	0
August-01	**$1.50 Smart Card ($47.00)**	**SMART/DDOT Regional Pass ($49.50)**	**SMART Park & Ride ($66.00)**	**Strip Tickets ($1.50)**	**Strip Tickets ($2.00)**
Totals	13	64	9	4	6
September	**$1.50 Smart Card ($47.00)**	**SMART/DDOT Regional Pass ($49.50)**	**SMART Park & Ride ($66.00)**	**Strip Tickets ($1.50)**	**Strip Tickets ($2.00)**
Totals	13	73	9	4	6
October-01	**$1.50 Smart Card ($47.00)**	**SMART/DDOT Regional Pass ($49.50)**	**SMART Park & Ride ($66.00)**	**Strip Tickets ($1.50)**	**Strip Tickets ($2.00)**
Totals	5	63	5	0	0

Table A2 Inventory of SMART's Commuter Choice Program (2001)